

WHAT IS CLAIMED IS:

2. A contour extraction apparatus extracting at least one contour of a target object from images obtained by an image pickup of the target object by cameras, the contour extraction  
5 apparatus comprising:
- a node locator locating a plurality of nodes on a periphery of a region, which includes the target object, within the image;
  - a contour deformation unit deforming the contour, which is formed by connecting nodes at a predetermined connection  
10 order, by shifting the position of each node to the position where a predefined energy function becomes minimum;
  - an internode distance calculator measuring internode distances about all combination of nodes constituting the contour excepting the internode distance between adjacent  
15 nodes; and
  - a connection creator creating a connection line to divide the contour when a combination of nodes whose internode distance is below a first threshold value exists, wherein
    - the connection line connects one of nodes in the  
20 combination with the node adjacent to the other node in the combination,
    - the connection line connects one of nodes in the combination with the node adjacent to the other node in the combination,
    - 25 the node adjacent to the other node is the node being positioning upstream or downstream in the predetermined

connection order with respect to the other node, and  
the first threshold value is determined in accordance  
with the distance to the target object.

- 5 3. A contour extraction apparatus according to claim 2,  
wherein

the first threshold value is set large as the distance  
to the target object becomes short.

- 10 4. A contour extraction apparatus according to claim 2 or  
claim 3, further comprising:

a target region determination unit determining the region,  
which includes pixels of the target object, as a target region  
based on distance information, motion information, and edge  
15 information, each information is generated for the target  
object from the image, wherein

the node locator locates a plurality of nodes on a  
periphery of the target region determined by the target region  
determination unit.

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5. A contour extraction apparatus according to claim 4,  
wherein

the target region determination unit: detects as a target  
distance the distance wherein a total number of pixel in which  
25 motion has been detected exceeds a second threshold value;  
obtains edge information of pixels corresponding to the image

within a region which has a predetermined depth in a fore-and-rear direction from the target distance; and determines the target region based on a centerline, the center line is a pixel array in which a total number of pixels  
 5 corresponding to an edge is maximum, the pixel corresponding to the edge is searched based on edge information.

6. A contour extraction apparatus according to claim 5 wherein

10 the target region determination unit establishes as the target region the rectangular region which has 2 meter height and has 50 centimeter width in a left-and-right direction from the centerline.

15 7. A contour extraction apparatus according to any one of claims 4 to 6, wherein

the target region determination unit terminates the establishment of new target region, when a predetermined number of contours have been established or when new target region  
 20 cannot be detected.

8. A contour extraction apparatus according to 7, wherein  
 the target region determination unit determines new target region from the region other than the region from which  
 25 the contour has been extracted and the region which has been judged as the region the target object is not in.

9. A contour extraction apparatus according to any one of claims 4 to 8, wherein

the target region determination unit establishes the  
5 target region further using color information obtained from the camera.

10. A method for extracting at least one contour of a target object from images obtained by an image pickup of the target  
10 object by cameras, the method comprising the steps of:

a node locating step locating a plurality of nodes on a periphery of a region, which includes the target object, within the image;

a contour deforming step deforming the contour, which is  
15 formed by connecting nodes at a predetermined connection order, by shifting the position of each node to the position where a predefined energy function becomes minimum;

an internode distance calculating step measuring  
internode distances about all combination of nodes constituting  
20 the contour excepting the internode distance between adjacent nodes; and

a connection creating step creating a connection line to divide the contour when a combination of nodes whose internode distance is below a first threshold value exists, wherein  
25 the connection line connects one of nodes in the combination with the node adjacent to the other node in the

combination,

the node adjacent to the other node is the node being positioning upstream or downstream in the predetermined connection order with respect to the other node, and

5 the first threshold value is determined in accordance with the distance to the target object.

11. A program which operates a computer for extracting at least one contour of a target object from images obtained by  
10 an image pickup of the target object by cameras, the program controls the computer to represent the functions of :

a node locator locating a plurality of nodes on a periphery of a region, which includes the target object, within the image;

a contour deformation unit deforming the contour, which  
15 is formed by connecting nodes at a predetermined connection order, by shifting the position of each node to the position where the predefined energy function becomes minimum;

an internode distance calculator measuring internode distances about all combination of nodes constituting the  
20 contour excepting the internode distance between adjacent nodes; and

a connection creator creating a connection line to divide the contour when a combination of nodes whose internode distance is below a first threshold value exists, wherein

25 the connection line connects one of nodes in the combination with the node adjacent to the other node in the

combination,

the node adjacent to the other node is the node being positioning upstream or downstream in the predetermined connection order with respect to the other node, and

- 5 the first threshold value is determined in accordance with the distance to the target object.